The Mecheleciv

VOL. X9 MARCH 1950 NO. 4

THE SCHOOL OF ENGINEERING
GEORGE WASHINGTON UNIVERSITY

THE MECHELECIV

Published at the George Washington University by direction of the Engineers' Council. Published six times during the school year in October, November, December, March, April, and May.
Subscription price: One Dollar

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● AN ESSAY ON INEQUITIES

Without attempting to include everything which may be considered as inequitable about the engineering school in general by our readers, we are going to try to set down some of the most obvious and easily correctible of these inequities, in the hope that something will be done about them.

Generally speaking, this editorial is a distillation of a number of discussions, all more or less heated, between groups of engineering students. Essentially, the most obvious inequalities are these:

(a) The assignment of problems, outside work, or experiments out of all proportion to the credit hours received for the course.

(b) The assignment of the same old experiments or problems year after year.

(c) The wide variation between the assignments by different professors teaching different sections of the same courses.

(d) The wide variations of the final and mid-term examinations between the various sections of the same course.

It seems to us, from the student's viewpoint, that it should be a relatively simple matter to do something about each of these. In connection with item (a), the University specifically limits the amount of outside work which is to be required of a student to two hours of preparation for each hour of credit to be received for the course.

Some professors realize that item (b) results in the handing down, from year to year, of copies of the solution to the problems or experiments. As a result of this, they feel free to increase the amount of outside work. Remember, gentlemen, there is always at least one unfortunate who cannot find a set of last year's material, and you're working him unfairly if you assign outside work on the above basis.

The last two items are self-explanatory. There appears to be no reason why there should not be a standard assignment sheet for a course, no matter who happens to be teaching it. This, together with a standard examination for the various sections of each course, would have the salutary effect of insuring that grades in any particular course would be given on somewhat the same basis, whoever the instructor or professor might be.

from the editor's mailbox

This space is intended to serve as a forum for student opinion. Opinions expressed are those of the writers, and not necessarily those of the Mechelecív, *Address communications to: Editor's Mailbox, the Mechelecív, Student Union Annex, George Washington University*
THE EDITORS.

November 26, 1949

Dear Editor:

Recently an article appeared in the Alumni section stating that I was working with the Patent Office. Since this information is in error, I would like to correct it, and at the same time say that I enjoy very much the consistently good issues of the Mecheleciv which somehow seem to improve each time.

I was employed by the Bureau of Ships of the Navy Department just after graduating and am now engaged in a year's training in the Internal Combustion Engine Laboratory of the U. S. Naval Experiment Station, Annapolis, Maryland. My main interest is in main propulsion plans for submarines. I am registered in the GWU Law School but have postponed further classes until I return to the Bureau of Ships next September.

How about publishing a request for information on Matt Polk BME '48, George Plondke BME '48, John Church BEE '48 . . . and all other BME '48 classmates.

Sincerely,
Raymond A. Coulomb.

● *Sorry we misplaced you, Ray, and thanks for the bouquet. If we were sure we would get such nice letters from everybody we might misplace someone every issue.—Ed.*

Dear Editor:

For your alumni notes I pass on the items that I am employed by the Mosstype Corporation in Brooklyn, New York, as production manager. They make rubber printing plates. I also passed the recent Professional Engineers' examination for New York State and have been given a license to practice engineering, and call myself an "Engineer."

I suggest that you print a blank in your magazine to encourage others to drop you a note; also contact alumni organizations in other cities for information. The alumni col-

umn should be one of the most interesting to the graduate, but it must not be monopolized by recent people (48-49).

John E. Lecraw.

● *The reason for notes on so many recent graduates is that they are the only ones our alumni columnist knows. We feel that your letter nominates you either to talk some of your classmates into writing us some news, or to rounding up the news yourself and sending it on to us. How soon do we hear from yo·· again?—Ed.*

February 10, 1950

Gentlemen,

I don't go much for the idea of writing gripes to some magazine generally, but this time it is so bad that I am writing you in the hopes that something can be done about registration. I can't see why I should have to stand in line outside the registrar's office for two and one half hours to get my registration forms, only to find when I get the things that one of the classes I have to get this time to graduate is closed. Why is it closed? Because there are a lot of guys who have a deal made with the people in charge so that they get to register early or get their blanks early, some way.

It seems to me that they should be able to figure out some way to avoid closing classes so soon. Maybe it would be a good plan to fix it so that those who have flunked a course have to wait and register late so that those who have not flunked, but are registering for the course for the first time, could get first crack at it. Also, why don't they fix it so that everybody gets his registration blank at the office in charge of his major subject? There wouldn't be so many people in the same line that way. While I am on this subject, I would like to say that I can't figure out how the grade index is arrived at by the School of Engineering. I keep a good record of all my grades, but I can't get the same index they do. I think the system used to do this should be explained in the catalog, so that everybody can keep his up to date.

Where is my January issue of the Mecheleciv? I did not receive it, and the February one has not come yet as of the time I write. I like the paper, but I think you should have more cartoons, some jokes and longer articles that tell more about things, instead of so many short articles.

C. W. A.

TABLE OF CONTENTS

About Our Cover . . .

This three-level highway bridge near the Pentagon Building in Virginia is a fine example of progressive highway planning.

● *You certainly did unload when you wrote us, C. W. A.! Beginning with the first item in your letter, those students who registered early were able to do so because they had volunteered to give their time during registration to help others register, thus reducing the time you had to spend in line. There were only about twenty of these men.*

The reasons classes must be closed are these: (a) laboratory facilities are limited, and crowding reduces the effectiveness of these courses; (b) lecture courses are considerably reduced in effectiveness when classes are so large that the instructor cannot give each student proper attention. Your idea about a ruling that flunkees be required to wait until everyone else has registered before they may register for that course sounds like a good thing.

We have been advised that it is considered impracticable to distribute registration blanks from any source except the Registrar's office because of the duplication of voluminous records that would be necessary. We also inquired about the grade index, and discovered that any courses not listed as required for your degree in the catalog are not included in your index by the School of Engineering. Physical education is not counted, and neither are those courses you may have had to take to make up entrance deficiencies.

There are no January or February issues of the Mecheleciv. See our masthead for publication dates. —Ed.

Dear Editor:

I want to use this opportunity to congratulate you and the rest of the Mecheleciv staff for the excellent job done in putting out the magazine in its present form. Especially the last two issues were superb, and contained material of great interest to every engineer—even a radio engineer. . . .

However, as to Alumni affairs in general, I have one gripe: except for the Mecheleciv and some general literature I am not informed at all of what's going on, and what to do to keep up contact with other former students. Especially I would appreciate it if you would pass on to the other brothers of Sigma Tau among the alumni this question: why is there no active Alumni Chapter of Sigma Tau in this area?

Data about myself: I am still at the same job which I held when a part-time student at G.W.U.: working for a consulting radio engineer here in Washington. My principal job is in the design of directional antennas for broadcast operations, but there is also some work connected with television, chiefly allocation problems.

I surely appreciated the story about George Kilpatrick's "blinding" effects, remembering Dave Carlson very well as being entirely capable of at least propagating such items of human interest.

Once more: my respect for the fine magazine you are putting out, and let's keep it up!

Sincerely,

Albrecht P. Barsis.

Engineering in Broadcast Stations

by Russell P. May

Consulting Radio Engineer

Reception of standard AM broadcast signals as we know broadcasting today, with its comparative clarity and freedom of interference from other broadcasting stations, except in outlying areas, did not merely happen this way, but is the result of many years of observation and research. In order to gain a clearer picture of the factors involved in the establishment of a new broadcasting station, it will be well to indulge briefly in retrospect, inasmuch as when broadcasting first began in the early nineteen twenties there were no particular designations for this type of station and others, particularly amateur radio stations. It was not uncommon at that time for a broadcast station to fire up his transmitter on any frequency to which it might be tuned, and not much regard was given to other stations, just so long as the signals could be heard in the immediate vicinity. Frequently the broadcaster would change to some other frequency which he considered better. Broadcasting was carried out on that basis for quite some little time. As the number of stations increased, however, the matter of interference became more and more severe and finally came to the attention of the government authorities.

During this early period it was observed that a different kind of interference existed, and it was that which occurred during the nighttime hours, and made possible the reception of far distant stations which could not be heard during the daytime hours, all of which added to the confusion. A great amount of study and investigation was made regarding the transmission of radio signals over the earth and the effects of the earth's characteristics on such transmission. Extensive investigation and observation was carried on with regard to the nighttime phenomenon and it was discovered that signals which were transmitted at night over extremely long distances had been reflected from a layer high in the sky, approximately eighty-five miles back to earth. This layer does not exist during daytime hours. It is known as the heaviside layer. During this period there sprang up an enthusiastic group of so-called DX listeners, who would stay up all hours of the night to hear the most distant stations. This was all very interesting, but was not conducive to good local reception. For a broadcaster to exist he must have interference-free reception inside of his own service area.

FM isolation unit at base of AM antenna.

In the year 1934 Congress passed the Communications Act of Nineteen Thirty Four, and provided for a Commission to administer the act and regulate all radio and communication transmissions. The present governing body is known as the Federal Communications Commission and their Rules and Regulations and Standards of Good Engineering Practice govern all activities in radio and tele-communications. The standard broadcast band was initially set up from 550 to 1500 kilocycles (it has since been increased to include the band from 540 to 1600), to be devoted exclusively to broadcast use. The Rules and Regulations and the Standards of Good Engineering Practice provided for the protection of broadcasting stations, from stations either on the same frequency or on adjacent frequencies, out to thirty kilocycles on either side. This means that in the establishment of a new broadcasting station not only the frequency under consideration must be carefully engineered, but the three adjacent frequencies on both sides thereof must also be considered.

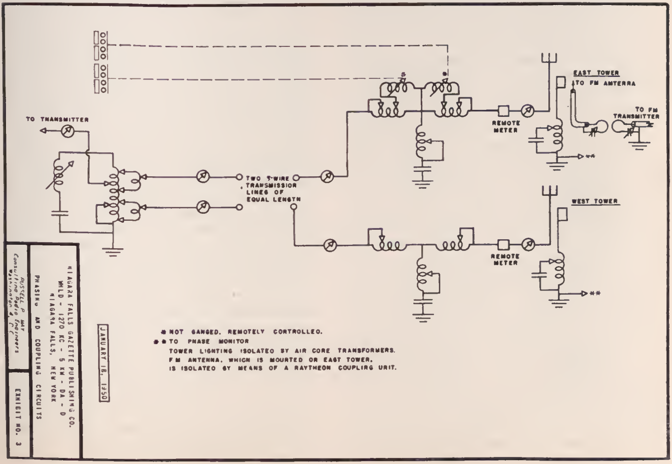
Before a broadcasting station can be erected it is first necessary to make application to the Federal Communications Commission for a construction permit. This application carries with it complete engineering data which shows how the proposed station will protect other stations on the above channels, both

during the daytime and nighttime hours. The earliest stations needed only to be concerned with a single antenna which developed for them a uniform circular service area. As time went on and the number of stations increased it is obvious that protection to the existing stations became more and more difficult, especially where one was confined to the use of a circular radiation pattern. Necessity stepped into the picture and the directional antenna was developed. This type of antenna consists of two or more antennas operating in certain relations to one another, both as to phases and current magnitudes. By utilization of spacing between towers, the number of towers, the current in the towers and the phase relation between the towers the engineer has several useful tools which he can bring into use to develop a directional antenna system which possesses almost any pattern shape one might desire, and which makes it possible to suppress or restrict radiation in the direction of the stations requiring protection and increase in corresponding relation the radiation in all other directions. It is obvious that, given a certain power, the antenna will have considerably more field strength in the non-protected directions that it would have if it were a basic single antenna.

Many stations utilize a non-directional single antenna during daytime hours and employ a directional antenna at night for the purpose of protection to other stations. Other stations directionalize daytime and nighttime, and usually in these cases the daytime pattern differs from the nighttime pattern in some respects. Generally the radiation toward the stations requiring protection at night can be let out considerably during daytime hours, which of course improves daytime coverage. Still another example of pattern differences between daytime and nighttime operation might include a pattern during daytime hours that is quite different from that employed at night. In most instances fewer towers are required for daytime operation than at night. In these cases it is of course desirable to employ part of the towers which are required for the nighttime arrangement.

Having determined the correct operating conditions of the various antennas for both nighttime and daytime operation, the method of feeding the antennas must now be considered. Power from the transmitter is fed into the tank, or power distribution circuit, as shown in the accompanying phasing and coupling circuit diagram. Under proper operating conditions this tank circuit is a purely resonant circuit, and possesses no reactance characteristics. The transmission lines are tapped on the inductor at the proper

Typical phasing and coupling circuit for directional antenna showing distribution tank and FM isolation unit.



point to provide the desired power to each tower. The usual type of co-axial or open wire line is suitable for this purpose. Phase delay networks are inserted in certain lines at either the transmitter or the antenna end of the line whereby the phase relations of the currents flowing into the antennas will be in accordance with the design values. It should be noted that the networks at the antenna end of the transmission line not only provide for proper phase delays but also provide the proper matching so that the power from the transmission lines will be transferred into the antennas at maximum efficiency. In this connection it should be noted that antennas operating in a directional array of this kind possess impedance characteristics which are totally different from the characteristics of a similar antenna operating alone. Characteristics are determined by the phase, current and spacing of the antennas. When operating in a directional array mutual impedances exist between the antennas, and they react in an extremely complicated manner on one another.

As an example of such reactions, one antenna operating as a non-directional antenna may have an impedance of 75 ohms resistance and 100 ohms inductive reactive. However, when this antenna and other antennas of similar structural characteristics are operating in a directional array, one of these antennas may assume a much lower resistance and reactance, and the same holds true for all of the other towers in the array. In some cases the resistance appears as a negative resistance. Variation of phase or current in any one of the antennas is accompanied by a change in the impedance of the other remaining antennas and therefore it is quite obvious that the problem of proper matching of each of the antennas for proper operation into the transmission lines is an extremely complicated one, and it is at once apparent that the adjustment of such an array must be carried out with the utmost systematization. When properly adjusted the transmitter will look into a load which is a pure resistance containing no reactance, and the transmission line currents will be equal at both ends of the line, indicating that there are no standing waves and that a perfect match has been attained. Before adjustment can be attempted it is first necessary to determine by actual measurement with radio measuring devices, such as bridges, signal generators, etc., the impedance of each tower and the mutual impedances caused by the reaction between towers when operating. Having determined the foregoing parameters, the networks similar to those shown in the diagram are then designed and set up. Small pick-up loops; as shown in the diagram, are mounted on the towers and pick up a small amount of the radiated energy from each of the antennas. This energy is fed back through small size transmission lines to an instrument known as a phase monitor which indicates the phase differences arriving at the ends of the transmission lines. If the lines are of different lengths, this of course has to be taken into account, but assuming all of the sampling transmission lines lengths to be equal the phase monitor will read exactly the phase relations between the towers. From this point on the engineer is occupied with the adjustment of antenna current and phase relations and field intensity measurements in the pertinent directions toward stations requiring protection. He must possess more than ordinary patience and endurance to carry out his exacting duties and at the same time placate an impatient management, who frequently have no understanding or sympathy for things technical and additionally set for a date for the formal opening of the new station which must be met. No sure-fire deterrent has been developed as yet to minimize this particular difficulty.

Power distribution equipment is usually located inside of the transmitter house, close to the transmitter, and emanating therefrom are the transmission lines, which pass out of the building and along poles or in troughs to the antennas. The networks at the antennas are contained in cabinets close to the base, and may or may not be located inside of a house constructed for the purpose. In any case the adjustment of these elements, especially in bad weather, is a real problem. As a rule the transmitting system is located remotely from the city and generally out in the country where, especially during the winter months, not too many conveniences are provided. In one particular instance, in the northern part of Vermont, we found it necessary to work on the adjustment of the antenna system during the winter. These adjustments and tests are always made after the sign off period at 1:00 a.m., and at that hour of the day the temperature can reach extremely low values. In this case snow fell almost continuously, and it was necessary for the town plow to clear paths between the transmitter and the antennas through which to walk. At times the path reached the depth of six to ten feet. Working at these hours we encountered temperatures as low as 35 degrees below zero, which are not conducive to enthusiastic efforts, especially when extreme accuracies are required. Fifteen hundred watt heaters had been installed in the tuning houses at the towers, but they made no perceptible change in the temperature. It might be of interest to note the device we resorted to, which proved to be entirely satisfactory. Rather than attempt to heat up the entire tuning house, a two hundred and fifty watt infra-red therapeutic lamp was installed in a place where it could be directed on the back of the person making the adjustments. It was found that a little more

(Continued on page eighteen)

George Washington University and Naval Ordnance

by Philias H. Girouard, BSME '26

To me it has seemed a pity that the George Washington University has seen fit thus far to say so little about its part in the past World War. I doubt that its role was equalled by any large number of the leading schools in the country. Its scientists and engineers led the way in many fields. One important field was that of rockets, in which it had no real competitor other than the California Institute of Technology. Many of its students, graduates and teaching staff were in uniform and, like Professor Norman Ames, made no small contribution in that capacity.

I do not pretend to be able to cover so broad a field as that of the University's contribution to the winning of the past war, but perhaps I can call attention to the important work done by its engineering graduates in the field of naval ordnance, with which I have some familiarity. I hope this account will lead other graduates to come forward with what they know concerning the part played by George Washington engineers in other important phases of the war effort.

Naval ordnance stems from the combined thinking and efforts of many people in the service and out of it, in industry, and in our educational and scientific institutions. The part played by the latter becomes greater as our national defense requirements encompass more and more of the total scientific capabilities of the nation. However, the last naval war was fought for the most part with weapons originated, designed and developed by the following: (a) graduates of the U. S. Naval Academy, who have spent many years in the study of the requirements of the fleet and of the aviation attached to it; (b) civilian engineers and scientists who have spent many years in the Civil Service in the various naval ordnance establishments as specialists in ordnance designing, developing and manufacturing; and, (c) certain manufacturers who devoted a large part of their total technical effort to the improvement of our national defense position. After Pearl Harbor, of course, the armed forces had the determined assistance of almost everyone in industry and in our educational and scientific institutions, and of many reserve officers, and their contributions were great indeed.

In the design and engineering and production of naval ordnance, George Washington graduates are no newcomers. Mr. W. C. Thom (CE '07) began his career as an ordnance engineer in 1904, and at the time of his retirement in 1948 was Chief Engineer of the Naval Gun Factory. He was intimately connected with design and manufacture of nearly all of the "shooting" ordnance used by the Navy during all of those years. In 1946 he received the Navy's Distinguished Civilian Service Award, the highest award made to a civilian by the Secretary of the Navy. In 1948 he received the George Washington University Alumni Achievement Award for notable achievement in engineering.

The late Mr. G. A. Chadwick (BSEE '24) also began his ordnance engineering career in 1904, and when he retired from government service in 1943 he was Head Engineer of the Bureau of Ordnance, Navy Department. His role was a major one in the design and development of the naval ordnance used in both world wars. He had conferred on him signal honors from the Navy Department for his contributions in those two wars, receiving the Distinguished Civilian Service Award in 1946, in part for his contributions toward the development of the atomic bomb.

It may be of no small interest for Mecheleciv readers to learn of the recognition accorded to some George Washington engineering graduates in the field of naval ordnance alone by the Navy for their outstanding contributions in ordnance matters. The table below records the honors received.

— Distinguished Civilian Service Award —	
Forest Bitner	BSME '37
Paul W. Burk	BSME '26 (two awards)
G. A. Chadwick	BSEE '24
F. F. Dick	BS in Chem '25 MS in Chem '27
P. H. Girouard	BSME '26
A. J. Stanton	BSME '25
J. M. Stockard	BSME '27
W. C. Thom	C.E. '07
— Meritorious Civilian Service Award —	
J. Fox	BSME '29
M. Goldberg	MA '29
J. A. S. Roy	BSEE '29

Mr. Bitner is one of this country's leading designers of projectiles and bombs.

Mr. Burk is without doubt one of the world's foremost designers of advanced, rapid fire ordnance.

Mr. Dick is one of our nation's few thoroughly competent experts in explosives. He is looked up to and much respected in this field.

Mr. Stanton is in the forefront in the design and development of heavy ordnance, such as turrets, in launchers for rockets and guided missiles, and in the larger calibers of anti-aircraft mounts.

Mr. Stockard has a varied experience in ordnance, both naval and military, but he is primarily an expert on underwater ordnance, and on torpedoes in particular.

Mr. Fox made an enviable record in the design of anti-submarine and anti-torpedo nets and booms during the war. His naval ordnance experience is also a varied one and he now supervises an important bomb design group.

Mr. Goldberg is a leader in gun firecontrol matters. He has twenty-five years of ordnance design experience and an enviable capability in mathematics.

Mr. Roy has contributed greatly to the advanced electrical and mechanical equipment in use in fire control directors, gun mounts and rocket launchers.

Mr. W. E. Patrick, Jr., consultant in the Explosive Department of the Naval Ordnance Test Station at Inyokern, California, has had a long career in the design of mines, depth charges, guns, aviation ordnance and rockets for Navy use. His valued service covers a period of over thirty years in naval ordnance. For his war work he too received the Navy's Meritorious Civilian Award from the Chief of the Bureau of Ordnance.

It has been the good fortune of the writer, who is proud to be a graduate in engineering of George Washington University, to have been awarded, upon the recommendation of the Chief of the Bureau of Ordnance, the Medal for Merit by the President of the United States for engineering contributions to the Navy during the war.

The above list includes the names of George Washington engineers who were awarded honors, difficult to earn, in the field of naval ordnance. It by no means includes all of the alumni engineers who contributed mightily toward the betterment of our fighting equipment at sea. For example, Mr. H. C. Connor (BSME '37), was in charge of the anti-aircraft mount design division at the Naval Gun Factory. He did an outstanding job in helping to prepare for manufacture the now famous 5"/38 naval guns and mounts. These were used in every theatre of the war at sea and on many hundreds of ships. Mr. Conner acted not only as design supervisor but also as engineering consultant for these and other important ordnance units. He has been in charge of the design of guns, rocket launchers and fire control gear for naval aircraft, and today manages the general engineering group at the Naval Gun Factory as one of that establishment's foremost engineers.

Mr. H. L. Boesch, who attended both the school of engineering and the school of law before World War I, played a major part in many phases of ordnance engineering in that war and in World War II. Today he is in charge of engineering standards and standardization in the Bureau of Ordnance and is well known in National Defense circles.

Mr. J. H. Rogers (BSME '35) helped in a major way in the design of anti-aircraft directors in use during the war. He is now head engineer in rocket design and development.

Mr. L. L. Ludlow (BSME '31) is one of the Navy's foremost designers of automatic and power drive equipment for ordnance units. Many hundreds of his drives were used in battle during the past war.

Mr. E. J. H. Lane (BSME '39) was an assistant to the Chief Engineer at the Naval Gun Factory during the war. Like many Gun Factory engineers his ordnance experience is a wide one. Today he is head engineer for naval ordnance underwater rockets and for guided missile warheads.

I have covered some of the activities of some of the leaders among our engineer alumni in the field of naval ordnance. I have not covered those of the many other engineers who are forging ahead in this same field, nor have I attempted to include the many engineers who are equally well known in other fields in the Department of Defense, like, for example, our beloved "Pop" McKnight, Vice-President of the Engineer Alumni Association, who was, prior to his recent retirement, a ship designer with over a quarter of a century of experience in activities under the Department of the Navy. "Pop" also holds a Meritorious Civilian Service Award from the Chief of the Bureau of Ships. Chester Thom, another outstanding alumnus, deals with shipboard guided missile matters.

During the past war the work of these George Washington engineers took them into many parts of this country and of the world, on land and on sea, in navy yards, manufacturing plants, fighting ships, and in many fields of design, production, construction and science. Their skill was applied not only to the betterment of our own Navy but also to the repair and improvement of the battle-damaged navies of our allies.

Their work was a credit to our University, a help to our navy and our nation and in accord with the best traditions of the engineering professions, whose standards they tried at all times to maintain and to improve.

Construction Cost Engineering

by C. C. Dimmette

No business can survive for long without a knowledge of costs and cost control. The construction industry is no more exempt from this rule than any other business. Cost control is very different for the contractor, however, as when he loses money on one job it may mean bankruptcy. There are many reasons for losing money on a contract, such as low bid, insufficient knowledge, increase in labor or material costs, or poor management.

Cost engineering is designed to prevent losses due to poor management and supervision. The distinction between cost engineering and bookkeeping should be emphasized. The former is a system of showing in money values the efficiency of workmen and machines; the latter is a means of recording debits and credits. The real purpose of cost control in construction is to keep inefficient management from eating into the profit.

On large construction projects it is not unusual to have one man assigned the duty of cost engineer of the project. It is not necessary that he be an accountant. In fact, an engineering education would probably be much more helpful. Upon his shoulders, rest the responsibility for making a profit.

As a preliminary to accomplishing effective control work on the job the cost engineer must be thoroughly familiar with the terms of the contract, know what the job is and how it is to be built, be conversant with the job progress schedule, and be familiar with the estimate. The cost engineer's next job is to prepare the account books that will be needed and to classify them in some sort of order. When the job starts he is responsible for seeing to it that all costs such as labor, material, and other are posted by the accountant in the proper place. This leaves the cost engineer free to analyze and study the costs as they come in and see to it that the job is going properly.

The cost engineer should follow some planned program to be in a position to advise intelligently. His first step would be to prepare a financial schedule of the entire job. This would answer such important questions as how much money will be needed and for how long. The schedule should be carefully prepared and will serve as a good indication as to how the job is going. A chart should be prepared showing the cumulative estimated expenditure and income plotted against time from which the contractor can tell approximately when he should begin making a profit.

Next, it is up to the cost engineer to utilize the cost and progress information to determine how the job is going. One of his most important tools is a periodic report showing the cost to date and the estimate to complete. These reports are broken down to cover different phases of construction work, such as foundations, form work, concrete placing, stripping, glazing, transportation, etc. Naturally, costs to date will increase while the estimate to finish will decrease as the job progresses. The opportunities to save money as a result of these reports will also decrease as the job proceeds. Consequently. the first reports should be given particular attention and study with the object in mind of adjusting jobs and cutting exorbitant costs.

Finally, the cost engineer should plan to send a series of reports to the job superintendent. The type of reports would depend upon the nature of the job, but would probably include the following: Labor control reports, detailed cost analysis of various items, periodic estimates of total probable costs, and the final report. The final report is of particular value as reference material for future bids and, therefore, should include all information that will be of use for this purpose.

The successful cost engineer should not stop at just compiling records of the cost of his own job, but should read the published results of others to learn what they are doing in this field and to keep abreast of the trend. By these means he will insure his company's profits and show his value to the construction industry.

SECOND SUCCESSFUL MIXER

The second semester of the school year opened with a bang when the engineers celebrated or forgot their last year's grades at the Engineer's Mixer. Plenty of beer, cokes, pretzels, and pop corn were on hand to assist in lubricating friendships, making the event even more successful than last Fall's Mixer.

As promised by the sponsor, the Engineer's Council, the welcoming address by Dean Feiker was short. The Dean entered into the spirit of the occasion and told a few of his famous anecdotes. He remarked that on his recent trip to England he was unable to get his suit pressed in less than a week, and that when he suggested to the hotel porters that they set up a one-day cleaning service at least for American business men who expected such service they immediately replied that they couldn't as that would take business away from the tailors. This illustration, Dean Feiker stated, showed the difference between the conservative English business men and the aggressive American business men.

Engineers enjoying the Mixer.

At the conclusion of the speech Bill Whittemore, able MC, led in singing a few old favorites. Singing proved to be quite popular, and as more bottles were emptied the volume increased. During the evening Cleveland Watkins, a communications major, volunteered to amuse the happy throng with almost professional imitations of noted statesmen. At later stages of the party some of the engineers decided to make up for the lack of snow in Washington by skating up and down the dance floor aided by powdered wax. Luckily there were no spills or collisions and most of the men left in good condition.

Hats off to the Engineer's Council for their fine repeat performance of last Fall's Mixer and our deepest consolations to those students who missed a thoroughly enjoyable evening by not attending.

ANNUAL CHRISTMAS CEREMONY

This year as in years past the Engineers of GWU presented a Christmas tree to the University shortly before the Christmas Holidays. Carrying on the tradition started by the late Professor Hitchcock of the School of Engineering, several of the boys traveled down to John McPhail's Virginia farm and selected a suitable tree. Later in the week all those interested parties gathered on Lisner Terrace and the annual erection problem began. With the aid of ropes and bare hands the tree was set upright in a box of substantial dimensions and nailed securely to the sides. After quite a discussion as to what material should be used to hold the box down, a few of our honest and upstanding engineers snitched the gardener's wheelbarrow while he was out to lunch and proceeded to cart sand from the huge pile in back of the engineering office to the back of Lisner Terrace. The wet sand provided plenty of ballast, but not forgetting their strength of materials the engineers increased

ENGINEERING SCHOOL CALENDAR

March 1950

March 1—Wednesday — Engineering societies meet, 8:15 P.M.

8—Wednesday—Theta Tau meets, D-200.

15—Wednesday—Sigma Tau meets.

16—Thursday—Engineers' Council meeting, 8:15 P.M., Student Union Annex.

22—Wednesday—Theta Tau meets, D-200.

25—Saturday—Theta Tau Regional Conference.

29—Wednesday—Sigma Tau meets.

31—Friday—Mecheleciv magazine out.

the factor of safety by adding guy wires before stringing up the Christmas lights.

The lighting ceremony, directed by Bill Whittemore and broadcast by station WINX, began with the selection of Christmas carols sung by the University Glee Club under the direction of Dr. Harmon. The program continued with the presentation of the Christmas tree by Dean Feiker to Dr. Marvin, President of the University. A photograph taken at the moment Doctor Marvin pressed the button which lighted the lights shows a very dubious expression of his face, as well as on that of Dean Feiker. Could it be that they didn't think the tree would light?

After several carols were sung, the group dispersed.

ENGINEER'S BALL

True to past traditions, the Annual Engineer's Ball turned out to be a grand success. Alumni, faculty members, and students bumped shoulders on the dance floor to the sweet music of the Alaskans, while many friendships were renewed at the surrounding tables. In fact, sociability was the theme of the evening bringing out the best in even the most serious-minded students.

During intermission, Bill Whittemore, President of the Engineer's Council presented lovely Beverly Howser, one of the few coed members of the engineering school, and she drew the winning stubs for the door prizes. Hap Irwin held the first winning ticket and walked away with a set of cuff links for himself and a cigarette case for his date.

Bill Whittemore, Engineers' Council President, presents door prizes to lucky winners.

The guests were at first slightly surprised by the balloons that they received as they entered, but engineering ingenuity was not stumped and soon balloons were bouncing around the tables like volley balls while others used their balloons for noise makers. It should be noted at this point that the noise was strictly noise. Those who did try to imitate the band and provide music for their companions by allowing air to escape from the partially inflated balloons failed miserably.

Adding to the enjoyment of the evening was the sign stating that Kohloss designed the air conditioning system. Our own Professor Kohloss denied vehemently that it was his job though it seemed to be in fine shape that night.

Among the faculty members present at the ball were Dean Colclough of th Law School, Dean Koenig of the Junior College, Dean Feiker and Assistant Dean Walther of the Engineering School, Professor B. D. Greenshields, Head of the Department of Mechanical Engineering. Professor Koehl (Physics), Professor Joule (Geography), and a large number of the instructors from the engineering school were also present.

22 ENGINEERS TAKE N. Y. TRIP

Twenty-two engineering students of the University attended the recent meeting of the American Institute of Electrical Engineers in New York.

University members visited the conferences on magnetic amplifiers and rotating machinery. Some of the field trips taken were a tour of the S.S. America, inspection of the Signal Corps Laboratories at Ft. Monmouth, New Jersey, and inspection of the new catalytic cracking plant of the Esso Refinery at Bayonne, New Jersey.

Engineering students that made the trip were: Bill Whittemore, Henry Doong, John Conner, Cleveland Watkins, Phil Watkins, Dick Daniels, John McPhail, Dick Yee, Bob Kiernan, Herman Schkolnick, Jerry Rockowitz.

Also, Collins Arsem, Richard Fling, Alcis Craft, Robert Johnson, Ed Egloff, John Held, Paul Miessener, Bob Zens, Sam Collins, Steve Andersen, and Mr. Jerry Antel, instructor in A.C. Machinery.

ALUMNEWS

Alumni are urged to keep their friends posted on what they are doing by submitting items of interest for use in these columns. Please include your address.

Bill Griffen, BCE '49, 1948 captain of the GWU Golf Team and one of the up and coming young amateurs around town, is now working at the Alexandria Iron works. He was recently married to "Jackie" Perry, the coed he squired about campus in his student days. They are living at 2309 N. 11th St., Arlington, Virginia.

Ray Coulomb, BME '48, who in a previous issue was falsely reported at the Patent Office has replied with a vigorous denial. Ray is with the Navy Dept. Bureau of Ships and at the present is engaged in a year's training program at the Internal Combustion Engine Laboratory of the U. S. Navy Experiment station in Annapolis. His main interests are in submarine propulsion units. His local address is 1929 2nd St., N.E., Wash. 2, D. C. P.S.—Thanks for the kind words, Ray.

George Gelly, former features editor of this publication who was forced to drop out of school because of ill health, is now in the hospital in Los Angeles. His address is 1301 Chavez Ravine Rd., Los Angeles 26, California. Here's hoping you are back on your feet soon, George.

Jerry Michael, BCE '49, is now at Johns Hopkins University studying for his Master's degree in sanitary engineering. The subject for his thesis is to be the effect of wind velocity on pollen counts.

Frank Braugh, BME '49, can be reached at 3441 N. Dousman St., Milwaukee 12, Wisconsin.

Marty Elf, BME '49, has a new home address: 623 S. Adams St., Arlington, Virginia.

Al Reidelbach, BCE '49, is now employed by CECO Steel Products Co. here in Washington. His home address is 2170 S. 27th St., Arlington, Virginia.

More kind words from *Al Barsis,* BEE '48, (see Mail Box) whose address is 228 Holly Ave., Takoma Park 12, Maryland.

Several alumni, including "*Pop*" *McKnight* and *J. Harold Link,* were present at the last Engineers Mixer. We hope that you had a good time and that the idea will prove even more popular at those that follow.

Al Barauck is with the Pacific Gas and Electric Company in San Francisco, California. His job at present is in services construction. Al has also turned "literary" and is on the board of editors of the San Francisco Engineer, a publication of all the Engineering Societies in the San Francisco section. A nice job, Al, from what we have seen. Al also saw Professor Akers this Fall in Los Angeles. Al's home address is 1820 Fulton St., San Francisco, California.

How about some more little items like the Kilpatrick story? What ever happened to the boys who used to drop their water filled lunch bags out of the top floor of old Lisner Hall, driving Librarian John Mason crazy???

The Engineer Alumni Association wishes to express its thanks to those Engineer Alumni who have sent in their contributions in response to the alumni letter forwarded with the December issue of Mecheleciv. The following alumni have contributed a sum totaling $174.00:

Albrecht P. Barsis	Philip W. Osborne	Thomas H. Heine
J. R. Boyd	Joel Reznek	Malcolm F. Hodges
Laurence Ray Brown	Wm. F. Roeser	John E. Lecraw
W. Robert Cannon	Charles A. Urbine	Edward G. Lippitt, Jr.
Philias H. Girouard	Ford Wheeler	Merwyn N. McKnight
Albert H. Helvestine	Murray Berdick	W. M. Pearson
Frank A. Howard	Roger T. Boyden	Carl Roeder
J. Harold Link	Frank Caldwell	H. H. Snelling
John T. McCubbin	James F. Fox	Lawrence G. Walter

The Association assumes that the rest of the Engineer Alumni have either mislaid or overlooked the alumni letter.

The Association would like for all Engineer Alumni to send in their correct addresses, so that all alumni will be sure to receive each issue of Mecheleciv. We also need these correct addresses so the Association can issue an up to date directory to the alumni. Why not send in that correct address when you send in the contribution and join the alumni listed above?

—ENGINEER ALUMNI ASSOCIATION

ENGINEERING PERSONALITIES

UNDERGRADUATE

At the moment Lenny Grant is connected with a variety of activities, none of them related to engineering, yet his background is tangled up with engineering as far back as his early high school days in Manhattan, where he became an electrician on the stage crew and even constructed a miniature theatre based on the Radio City Music Hall.

Finishing high school, he entered Princeton University to study electrical engineering. At the end of two semesters he enlisted in the Army, and as an exception to the Army's legendary placement theory he was assigned to the Engineers. He joined a reconnaissance Group which as their major contribution to the ending of the war placed three pontoon bridges across the Rhine.

Following his discharge in the Fall of 1946, he entered George Washington University only to find that practically all of the engineering courses were filled. During the Spring he was simultaneously enrolled at GW and American University, the latter for his Physics course. Despite the fact that he spent most of his time on the bus between schools, he still had time to work with the GW Players as electrician and painter.

As Lenny began to tangle with the finer points of electrical theory, he saw that it was not for him. Joining the ranks of the disillusioned would-be electrical engineers, he switched to a B. S. in Engineering with a major in Business Administration. He also pledged and was initiated into Phi Sigma Kappa. Lenny also joined the University Dance Production Group last Spring. As his junior year drew to a close Lenny entered campus politics and was elected Student Council Program Director. The major task of this position has been planning the Colonial Program series. Some of the outstanding items of the series have been the Oxford-GW debate, presented as part of the Homecoming Week Program, the Air Force Band concerts, and Handel's "Messiah" presented jointly by the University Glee Club and the Air Force Band.

Lenny has another administrative chore as chairman of the Student Union Committee. This committee plans the operation of the Student Union and acts as intermediary between the students and the school government. One sample of his troubles came from the fire house next door. The complaint was that the bells on the pinball machine were being confused with the bells on their alarm system. The loudest scream of protest over a proposed removal of the machines came from the engineers, who, Lenny notes, make up a large body of the pinball operators.

Lenny's other activities include membership in the Society for the Advancement of Management and Alpha Kappa Psi, the business professional fraternity. Recently he has been writing for the Hatchet, largely by default, when he became dissatisfied with the publicity given his Colonial Program series.

ALUMNUS

The alumni personality for this month is, in our opinion, one of the original Colonial Boosters. A lot of GW graduates have watched us grow from a handful of buildings in "foggy bottom" to a modern university, but William J. Ellenberger has not only watched but spent considerable time aiding, and telling others about the miracle of twenty-first street.

Mr. Ellenberger moved to Washington early enough to acquire the title of native Washingtonian, a rare thing indeed today. He attended Central High School and upon graduation enrolled here as a night school student. His days were spent with the Potomac Electric Power Co. His schooling was interrupted at about the half way point when he left town to work for General Electric. He says that he still feels that the days spent with GE as a student engineer were among the most valuable professional experience he got and he is a strong advocate of such programs for the graduating engineer. Returning after two years to PEPCO and GW, he received his BS in EE in 1930.

He received a reserve commission in 1935, so the war scare had Mr. Ellenberger packing his things in preparation for a brief sojourn with Uncle Sam. The army, however, found a few minor physical defects and delayed his orders to active duty until 1942. In the meantime he returned to the GW night school, but as an instructor this time.

His first army assignment was with the Signal Corps Procurement Division where the constant battle was to obtain enough of the critical materials to keep our field forces supplied. In 1943 he was transferred to the International Division of the War Department, in the lend-lease division, and went to London from this department in 1944 for a brief stay. On a second trip to London, he stayed and worked progressively on problems of getting equipment and materials to our Western forces, then to our Pacific forces and finally winding up lend-lease accounts in London. He was returned to inactive duty in 1946 with the rank of Lieutenant Colonel.

Upon his return to civilian life Mr. Ellenberger became Plant Superintendent of the Bureau of Standards. His job covers the design and maintenance of the plant and facilities, and affords plenty of tough problems in a research laboratory that has been growing as erratically as the Bureau has.

Mr. Ellenberger is Engineering Vice President of the General Alumni Association, and the alumnus member of the University Committee on Publications. His student activities included membership in the old George Washington Engineering Society, Pi Theta Xi (the forerunner of Theta Tau) and Acacia social fraternity. He is an active member of the local sections of the AIEE and ASME, and the Washington Society of Engineers.

● On Wednesday, January 4, the AIEE held their first meeting of the new year. The guest speaker for the evening was Mr. Reed, chief engineer of the Potomac Electric Power Company. Mr. Reed has had a great amount of experience in the teaching and guidance of young engineers, having instructed at the University of Virginia and Columbia Tech in addition to his twenty-eight years' service with PEPCO. His topic for the evening dealt with the future outlook for young engineers.

Mr. Reed pointed out that while there are a great many electrical engineers (62,000 in AIEE alone), there is no cause for the present pessimism over obtaining jobs. The field is not over-crowded. Future plans for power plant and industrial expansion have brightened the outlook considerably, and are expected to extend over a long period of time.

The sound advice passed on by Mr. Reed included many points that have been emphasized before by various members of the faculty of our university, and cannot be repeated too often. These points include: the correct use of the English language, proficiency in the use of mathematics, careful, correct note-keeping for future reference, and constant utilization of one's powers of concentration.

Mr. Reed placed special emphasis on the code of ethics set up for those in the engineering profession. He indicates that it is more important that the engineer circulate and develop a well-rounded social life than it is to devote himself entirely to technical duties. Above all he should not regard a job as a dead end, but as a stepping stone to greater achievements.

AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852

● The last technical meeting of the GWU chapter included as speakers two prominent engineers who united in a discussion of the Dupont Circle Underpass from the respective view points of the District government and the contractor. Mr. Tillinghast, Chief Engineer for the John McShain Co., and Mr. Darnell, Assistant Resident Engineer of the Underpass, presented briefly some of the outstanding features of both the design and construction of the project and then answered very efficiently the horde of questions put forth by society members.

All of the ASCE's who attended the Christmas Frolics had a very enjoyable evening with their wives and dates out at the Lyon Park Community House in Arlington, Virginia. Among the amusing highlights were the efforts of George (Boy Scout) Titrington in keeping the fire burning with kindling which looked suspiciously like fence rails from a nearby home and the antics of "Gigolo" George Goforth, who fed and danced with the middle-aged female caretakers, keeping their eyes off of both the clock and decanters hidden in sundry places.

At the beginning of this new school semester, we of the George Washington University Student Chapter of the American Society of Civil Engineers would again like to invite all civil engineering and bachelor of science in engineering students to join our fold and share with us both our technical and social activities for the coming year. Let's have a big turnout at our next meeting on March 1.

● The student chapter of the ASME reports two fine meetings since the last issue of the Mecheleciv. The first of these was the regular January meeting, at which we were fortunate to have Dr. William Avery, the head of the Launcher Section of the Applied Physics Laboratory of Johns Hopkins University, for our speaker. Dr. Avery discussed the development of the guided missile program, illustrating his discussion with slides. A lively question period followed, and although Dr. Avery was obliged to decline to answer several questions fully for security reasons, the question period was very interesting. A short technicolor movie of experimental flights of recent guided missiles, including some interesting captured German films, concluded the evening.

Although the regular meetings of the engineering societies were not held in February because of the Mixer, the ASME held its annual student paper presentation meeting on February 6. Papers were presented by Harry Croswell, Nick Chacos, Sol Finebloom and Rudolph Volin. The audience judged the papers, and Harry Croswell was adjudged the winner. Croswell spoke on "The Development of the Bus." This is the second time Croswell has won the competition. Sol Finebloom was runner-up with an original paper on a little-known phase of flood control.

The next meeting of the society is the regular March meeting, scheduled for March 1, at 8:30 p.m. in Government 101.

● Members of the IRE were treated to an unusually clear demonstration of the characteristics of phase fronts when Mr. Allen H. Schooley of the Naval Research Laboratory spoke on "The Ripple Tank and the Visualization of Phase Fronts" at the January 4, meeting. Mr. Schooley showed films and slides taken of the standing waves generated in his ripple tank. The ripple tank consisted of a shallow tank of water agitated by a probe driven from an audio oscillator. When viewed from light chopped in synchronism with the signal driving the probe, the spreading ripples appeared as standing waves. Thus, the effect of parabolic reflectors, microwave lens, wave guides, reflection of waves from aircraft, and antenna arrays

upon phase fronts could easily be visualized by corresponding analogies of probe and reflecting blocks in the ripple tank. Mr. Schooley's demonstrations helped all present to obtain a better understanding of the behavior of phase fronts in microwave propagation.

On December 15, IRE members were the guests of the Westinghouse Electric Corporation at their electronics division in Baltimore. Commercial radio transmitting units, and other electronic equipment in the process of being manufactured were seen during the inspection of the plant. At the close of the inspection tour an instructive talk was given by a company official upon the opportunities offered the junior engineer by the Westinghouse and other large corporations.

If there is some field trip that you would like to make this spring and you think it would be of general interest to the society, speak up. If it is at all possible, every effort will be made to arrange it. Your suggestions are welcome.

● On December 10, Sigma Tau decided they had seen the ads picturing the lasses with the thin skirts saying "We are at the Sheraton Lounge—where are you?", an attitude that was more than slightly attractive to "wolfish engineers." The meeting was therefore called into some semblance of order at the Sheraton Lounge, and the members partook of refreshment. The group then adjourned to the banquet room upstairs. The reason for all this revelry was to celebrate the initiation of thirty-one new members: Arthur Bailey, Richard Balinger, Chester Bilinski, Kenneth Bonwit, Edmond Brzozaski, John Clancey, Vincent Cleary, Daniel Dotson, Forest Dupre, Edward Egloff, Lynn Garrison. Floyd Jennings, Edward McGrady, Chistos Maskaleris, James O'Conor, Ellis Packer, James Robbins, Michael Saba, Emmitt Sadler, John Simeroth, Edward Simonetti, Milton Sing, George Stomack, George Titrington, Carl Tonti, Willis Vary, Elias Wineberger, Robert Wise.

The banquet got under way with only small loss in personnel when the transfer from the lounge was made. Having dined sumptuously on shrimp and steak the old members sat back to enjoy the entertainment planned by the new initiates. Vince Cleary sang a spirited Sigma Tau song, and two other groups struggled through scenarios on college life.

The real tragedy of the evening was the fact that Deacon Ames was not present to enjoy a painfully true sketch of a day in the EE Lab.

Two elections have recently been held to fill offices vacated by graduating members. Frank Thompson was elected Vice President to succeed Dick Bortik, and Edward Egloff was elected to represent Sigma Tau on the Engineers' Council to replace Joe Irico.

Sigma Tau members are looking forward to a big party in the near future. A special committee is working on the details, and so far has run into one snag—no one has offered a place where such a party may be held. Anyone having knowledge of a suitably reinforced hall will please step forward!

● This month Gamma Beta chapter will be host of the regional conference to be held March 25. The conference is a general fraternal get together and exchange of ideas among brothers from the University of Virginia, North Carolina State, Columbia University, Syracuse University, and our own chapter. The one-day program beginning at 9:00 A.M. will include conference sessions in the morning, an initiation of our present industrious pledge class in the afternoon and a gala banquet and dance starting at 7:00 P.M. at the Burlington Hotel. Alumni brothers are urged to turn out in force to enjoy the day's program. Preliminary arrangements can be made by notifying Vice Regent Art Schraitle (CH 5618), or by dropping a post card to the chapter.

Congratulations are in order for a new father, Scribe Howard Grayson. Brother Grayson nearly popped every button on his coat over a healthy legacy to Theta Tau (boy, that is). The cigar smoke was so thick at the last meeting that several of the communications boys have threatened to bring radar sets the next time such an event is in the wind.

Regent Titrington was pleasantly surprised at the chapter meeting before Christmas when he was presented with an electric mixer by his fraternity brothers. The choice of the gift was influenced by the fact that George had been smoking cheap cigarettes for months while saving coupons for the mixer. Now he is back to his regular brand and we can all borrow cigarettes again.

On New Year's Day George and Sue Titrington were hosts of the chapter to give the boys an opportunity to sample the wares of their new mixer. Their rum punch, which was made from an original recipe, will live for a long time in the memories of those who drank it. Cashman's well-known earthy humor contributed much to the general enjoyment of the evening.

On January 8th, as a sort of pre-exam fling, the chapter journeyed out to the Shady Oak Inn for an informal party that turned out like all Theta Tau parties, good till the last choral group slipped away into the night. Brother John McPhail's amateur photography turned out to be professional in appearance. Reprints of all pictures taken can be obtained for a small fee. Brother Whittemore unexpectedly proved to be quite a jitterbug, when the tempo of the records got too fast for the less active brothers.

Two new officers were elected at the February meeting. John Lewis was chosen for the office of Treasurer, and Bill Whittemore was picked for Corresponding Secretary. The pledge class, not to be outdone by the members, also held elections and chose Bill Seabrooke as President.

Measurement of Rainfall

by John T. Clancey, Jr.

Rainfall is measured on the basis of the vertical depth of water, which would accumulate on a level surface, if all of it remained as it fell and none flowed or soaked away or was lost by evaporation. The usual unit of measurement is the inch.

The standard rain gage used by the United States Weather Bureau consists of a galvanized iron cylinder can, eight inches in diameter and two feet high, the mouth of which is circular, leveled on the outside to form a sharp edge. This receiver is funnel shaped and discharges into a receiving tube. The receiving tube has a cross-sectional area one-tenth that of the cylinder. The depth of the rain caught in the receiving tube is determined by means of a measuring stick to tenths of an inch, thus measuring the rainfall caught in the gage to the hundredth of an inch.

The standard rain gage gives the rainfall only between the daily readings. Automatic recording gages are used for determining the rainfall during short periods of time. The recording gage perhaps in most general use in this country is the tipping bucket gage. This gage is constructed so that when a bucket becomes filled with one-hundredth of an inch of rainfall, it tips, and empties into a cylinder below. The tipping of the bucket moves a pen which has been tracing a line upon a chart moved by clockwork, causing a jog in the line on the chart. The pen reverses after every fifteen jogs and makes jogs in the opposite direction. The chart is removed at the end of every twenty-four hour period and the pen movements are counted and recorded. The rate of rainfall can be then computed and recorded.

Other recording gages operate by floats or by weighing. In the case of the float type of gage, a float rises and falls with the increase and decrease of the water level within the cylinder and by so doing traces a line upon a revolving drum, which is moved by clockwork. As the cylinder fills with rainwater, the float rises. The slope of the line traced by the pen chart indicates the rate of rainfall. In the Marvin weighing rain gage, the vessel is kept in balance as the rain descends, by a counter weight which is automatically moved by a magnet. Each impulse which is recorded in the sheet attached to the revolving drum, corresponds to one-hundredth of an inch of rainfall.

Gages, both recording and ordinary, must be carefully located to obtain accurate results. The wind is the most disturbing cause. When it blows against the gage, it forms eddies near and above the gage and frequently carries away the rain. The stronger the wind, the more it affects the catching of rainfall. Gages are usually placed with their openings about thirty inches from the ground, where trees and buildings will not set up irregular wind currents. Gages should be exposed upon roofs of buildings only when better exposures are not available, and when so located, the middle portion of a flat, unobstructed roof, generally gives the best results. A description of the location of the gage and its surroundings should be recorded.

Silicones

by Chester Bilinski

Silicones are a group of synthetic semi-organic compounds that combine many of the more desirable virtues of organic and inorganic substances. Their basic chemical structure is a molecule consisting of alternating silicon and oxygen atoms. By itself this skeleton would be a purely inorganic, rigid substance such as sand or quartz. Accordingly, silicones, as a class, possess the high immunity to heat, cold, chemicals, and weathering that is typical of such rigid bodies.

The addition of any one of a large number of organic groups to the silicone atom gives the flexibility and plasticity that is typical of organics and that is needed to make silicone substances workable in a variety of applications.

Silicone products are produced in a range from semi-volatile liquids to rigid solids and may be divided into four main classes: (1) oils and greases, (2) rubber, (3) resins, and (4) water repellents.

Oils:

Silicone oils are clear water-white liquids made in viscosities ranging from that of a light machine oil up to those of semi-solid consistencies. Characteristics that make them attractive for applications where conventional oils are unsatisfactory are: (1) small change in viscosity from low to high temperature, (2) high temperature stability, (3) low pour point, (4) chemical inertness, (5) good electrical properties and (6) resistance to shear breakdown. Because of one or more of these characteristics, the oil is suitable for applications in the following fields: (1) as damping oils, dielectric fluids, and manometer fluids, (2) in hydraulic systems, (3) as lubricants, and (4) in condensation pumps.

Silicone Rubber:

One of the most important members of the silicone family is silicone rubber. Its unique properties of high heat resistance, low temperature flexibility, and

low permanent set, lead to its use as gasket material in such diversified applications as (1) baking-oven doors, (2) high powered searchlights, (3) diesel engines, and (4) packaging equipment.

All grades of silicone rubber can be exposed continuously to temperatures of 300 to 325 F., with little increase in surface hardness, or decrease in flexibility or resiliency. Results are the same for short-time exposures up to temperatures as high as 520 F. Even at this temperature, there is no tendency towards softness and the rubber will not stick or adhere to metal surfaces.

These properties provide excellent gasketing action in baking and drying ovens. Gaskets operating continuously at 400 F., will give up to 18 or 20 months service.

Other gasketing jobs for which the properties of silicone rubber are desirable are found in stationary diesel engines, gas turbines, air compressors, turbo-superchargers, and the sealing of small liquid-filled capacitors.

This latter application makes use of not only the high heat resistance but also the low compression set, good dielectric properties, and the chemical resistance of silicone rubber. The absence of plasticizers in the rubber prevents contamination of the dielectric caused by leaching action on the gasket.

Silicone rubbers also make possible better oil seals around high-speed shafts. Conventional gaskets will swell in oil, friction is increased, and the resultant temperature rise may cause the seal to soften, stick to the shaft, and be torn apart. Silicone rubber also swells slightly, but its resistance to heat lessens the danger of trouble from increased friction.

In the electrical field, it has numerous applications as an insulating material, including rubber-coated lead wires, glass cloth for slot cell insulation, and rubber-coated tape for coils.

Silicone rubber can be obtained as extruded shapes, molded parts, flat sheets, fabricated stock, or coated glass cloth. Adhesives for joining silicone rubber to itself or other surfaces are now available to extend the field of application.

Resins:

Silicone resins are particularly well adapted to insulating functions in electrical apparatus.

Their outstanding properties include high thermal stability, good dielectric properties, and resistance to moisture and some chemicals.

Although other considerations are near-limitations on machine ratings and must not be overlooked, the increased thermal life of silicone-treated insulation offers several possibilities in machine design:

1. Reduction in size and weight.
2. Increased insulation life where present operating temperatures are maintained.
3. Operation at high ambient temperatures, which may be of value in boiler rooms or other hot areas.
4. Greater overloads for longer periods.
5. Improve the flame resistance of insulation.

Water Repellents:

Silicone water repellents are a group of liquids and compounds that can be applied to ceramics, paper, viscose and acetate rayon, cotton, fabric, wool, nylon, plastics, glass, quartz and leather to enable these materials to shed water.

Vapor treatment of parts is carried on in an inclosed cabinet containing provision for vaporizing the silicone liquids and circulating the vapors.

In liquid form, water-repellent treatments have been used on glass to decrease the clotting time of blood and to keep the inside surface of glass flow gages free of contaminations.

Silicones should not be regarded as a panacea. They appear to possess many outstanding properties, particularly as regards resistance to heat and cold. Yet a great deal remains to be learned about them. Their successful application requires analysis and careful study. Their introduction into new fields should come about in an evolutionary manner, after thorough consideration of their merits for the particular requirements.

(*Continued from page six*)

heat was supplied than desired. This might be kept in mind for your future use.

The adjustment of any directional antenna system is complicated and is made more so by the addition of towers. As stated before, any change in a tower is accompanied by changes in other towers which must be compensated for. All of this requires a large amount of traveling back and forth between towers and transmitter building, transporting the measuring equipment at the same time. The final proof of proper adjustment is the proper phase and current relations and the prescribed field intensities in the various pertinent directions. Once these have been established, the actual field measurement work begins. These measurements are known as the 'proof of performance'.

The proof of performance is made in order to prove that the antenna system is functioning exactly as predicted in the original calculations and as embodied in the construction permit. In order to show that the conditions have been met a series of field intensity measurements are made. Radials are drawn on a map using the location of the antenna system as a center. These radials extend at directions which include all of those bearings toward the stations requiring protection and in addition several other directions over the service area of the station. Measurements are made at intervals of one tenth of a mile for the first two miles out from the station, five tenths of a mile intervals for the two to six mile section, and at two mile intervals from six to fifteen or twenty miies. The number of radials required in a proof of performance ranges from approximately 14 to 20, depending upon the number of protections. All in all, there are several hundred measurements required in the completion of a proof of performance, not to mention the numerous measurements which must be made during the adjustment period. During the field measurements, one encounters every conceivable inconvenience, inasmuch as these measurements must be made exactly on the radial. If the point cannot be reached by car, the equipment must be walked in to woods, swamps, mountains, through slush, snow and water. In extreme cases mule pack has been resorted to in order to negotiate the rough terrain of mountains and otherwise almost inaccessible places. On one occasion during the early summer when the foliage was in full dress, we found it utterly impossible to determine our location on the map, and it was necessary to return to the job after the leaves had fallen and before the ground was obscured by snow. This was on the northern Vermont job mentioned before, and even in the Fall it was necessary to employ a guide who was able to identify old roads and land marks shown on the archaic maps which we had to use. Some idea of the time and effort which is required to make the proof of performance may be gained from the foregoing, coupled with the fact that in those cases where the pattern during daytime hours is different than the nighttime, measurements must also be made under daytime operating conditions, which doubles the number of measurements required. Under these circumstances, in the case of a new station, a method of operation is necessary whereby the transmitter engineer switches from one pattern to the other according to a prearranged schedule, or a radio communication system may be set up from the field back to the transmitter to transmit instructions to the engineer there. Not all field jobs are as rigorous as has been described herein, and many of them are carried on under the most pleasant circumstances. These, however, are the exception rather than the rule. Once a job is finished the field engineer is well aware that he has been places and seen a lot of the country. One has to be prepared for all sorts of weather, and occasionally measurements may even have to be taken on boats, in planes, or on skiis or snow shoes.

—*W. P. Woolls*

All the information obtained by field measurement and other important information, such as phasing and currents in the towers, is correlated back in the home office, and a very comprehensive report is prepared showing polar diagrams of the patterns obtained, graphic plots of the field measurements on log log graph paper along each of the radials for both patterns, maps showing accurately the points of measurements, coverage contours of the station, tabulations of all data and other information to prove that the efficiency of the array meets with the requirements of the Standards of Good Engineering Practice of the FCC. The station then applies for a license to go on the air. Having satisfied the Federal Communications Commission that the array is in proper operation, the station is permitted to go on the air on program test authorization while waiting for the issuance of their license for regular operation.

Many of the foregoing points can be well illustrated by a discussion of one of our most recent jobs, the new transmitter installation at radio station WHLD. This station is owned by the Niagara Falls Gazette Publishing Company, and the transmitter is located on Grand Island, just across from the city of Niagara Falls. The island is in the Niagara River between the United States mainland and Canada, about three miles above the famous falls. The severe winter conditions which prevail in this area dictated that unusual measures be taken in the building of a plant of this kind, both as regards reliability of operation and the convenience and comfort of the personnel. Meticulous attention was given to all structural details of both the building and the technical equipment. The building houses the five kilowatt AM transmitter and the ten kilowatt FM transmitter. Provision has been made to accommodate a television transmitter at a future date. Two large studios are included. Centered within these facilities is a large double control room so one operator can supervise all of the transmitters and operate the studio control consoles. A complete two-bedroom apartment is provided for the use of the Chief Engineer, and a small bachelor type apartment for the use of the maintenance engineer. The building is air conditioned throughout and is decorated in the most modern manner. Ample shop and garage facilities round out the installation.

A minimum of difficulty was experienced in getting this plant into operation, which speaks well for the care and experience that went into its planning and construction. When construction was completed and the installation was ready for adjustment preparatory to tests and placing into operation, Fred Lee, of our Washington office, loaded his car to the gunwales with test and measuring equipment and proceeded to Niagara Falls. He arrived the following day and promptly began the necessary measurements and adjustments. This required several days, and I arrived after a part of the field measurements were completed, but I did get roped in on the field measurements which were to be made in Canada. Special arrangements had to be made with the Canadian government through our State Department to permit these measurements, and as might be expected, the red tape was plenty deep at the customs gate when we presented ourselves for entry.

Field measurements proceeded smoothly except for a few days, when Grand Island was inundated by a storm of hurricane proportions. During this time the inhabitants were confined close to their houses, as the roads were under water, especially at the rivers edge, where the writer was a guest of Earl Hull, Vice-president of the Niagara Falls Gazette Publishing Company, and the general manager of the station. The delay, however, was not without compensation, as it became the occasion for renewal of neighborhood acquaintanceships, and impromptu cocktail parties.

A feature at this station which is occurring frequently now in new stations was the inclusion of the FM facilities. The station has an application presently pending before the Federal Communications Commission for television facilities, and this, too, must be provided for. One of the AM antennas is made to serve as a support for the FM antenna, and another will serve to support the television radiator if the pending application is approved. In order to feed the FM antenna on the top of the AM radiator, the transmission line for the FM signal is brought into an isolation unit at the base of the AM tower, and piped to the top. This eliminates the possibility of disturbance to the proper operation of either of the antennas by the other.